FOREST RESEARCH NOTES

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
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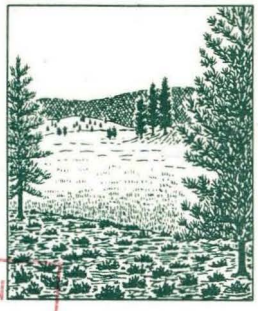
U.S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE



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GERMINATION OF FOURWING SALTBUSH SEED IMPROVED BY SCARIFICATION AND GRADING

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One of the objectives of game-range restoration is to increase herbage production on critical areas such as winter ranges. Browse, the preferred feed during much of the winter, is particularly valuable when the low-growing herbaceous plants are covered with snow and cannot be reached by the animals. Yet desirable browse plants on many deer winter ranges have deteriorated and become so limited that heavy deer losses occur in some years. Research to develop methods of reestablishing and extending browse species suitable for food and cover on these deteriorated ranges is underway in several western states.

One browse species which offers good possibilities for improving deer winter ranges by artificial reseeding is fourwing saltbush (Atriplex canescens). It is ecologically adapted to many deteriorated semi-desert deer winter ranges, is capable of furnishing valuable food and cover for game and livestock, and is useful for erosion control (6). Reseeding trials in Arizona have shown high herbage yields from first year plantings (4).

Despite its promise, past experience with fourwing saltbush has been inconsistent and not entirely satisfactory. One reason is its variable and generally poor seed germination.

In preliminary work at the California Forest and Range Experiment Station, excizing the embryos has shown that saltbush has a potential considerably higher than actual germination. This difference suggests that the seed-coat covering retards germination. Beadle (1) attributed the reduction to the high percentage of chloride in the seeds. Koller (3) determined on another Atriplex species that it was not chloride, but a water-soluble extract diffused from the fruit bracts or wings that apparently caused the inhibition. This extract, which had a high osmotic pressure, was not identified.

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Several treatments have been used to increase germination. Germination varied with methods of storage and removal of wings from the seed in studies made by Hervey and Boyd (2). They found that mature seeds germinated better after 1 year's storage in sealed containers at ordinary room temperatures. Twitchell (5) was able to increase germination by soaking the seeds in water and drying them for several days before planting. Planting immediately after soaking was unsuccessful.

Our results with water-soaked seeds were inconclusive. Four hours of soaking followed by 8 days of air drying increased seedling emergence 5 percent in field plantings, but did not affect germination in the laboratory. In these tests the "smaller" seeds germinated better than the "larger" ones. This suggested additional tests--on germination in relation to seed size and on methods of inducing germination.

TEST OF SEED SIZE

Seed collected in 1952 in New Mexico and Arizona, was hammermilled and graded into four classes (table 1). Grading by gentle agitation over oblong, slotted sieves provided a maximum and minimum diameter range in each class. The sieves were commercially available standard sizes; hence the graduations were not necessarily uniform throughout.

Each test included 16 replications of 25 seeds each. These were germinated at ordinary room temperatures for 15 days on moist filter paper in covered Petri dishes. The germinated seeds were counted and removed daily.

Germination varied inversely with seed size. The smallest seeds averaged 54 percent, against 33 percent for the large seeds. Intermediate sizes ranged between the two extremes. The differences obtained were highly significant by analysis of variance (table 2). This analysis also indicated that the relationship between seed size and germination prevailed in this test for both seed sources.

This study did not reflect the effect of scarification during hammermilling. The milling probably removed part of the seed coating which retards germination. To test this point further and develop the effects of scarification on germination, another study was conducted using hand-scarified seed.

EFFECT OF SCARIFICATION ON GERMINATION

Using the same germinating conditions and seed numbers as in the test of seed size, large seeds were hand rubbed between sheets of fine sandpaper and tested for germination. Three classes of scarification were compared. Heavy scarification constituted rubbing until the seeds would pass through 1/12-inch sieve openings, but were retained by sieves having 1/14-inch openings. The limits for moderate scarification were 6/64- and 1/12-inch openings. The third class consisted of seeds that were hammermilled only.

Only the heavy scarification increased total germination substantially: 42 percent compared to 31 percent for both negligible and moderate. This difference was statistically significant.

Table 1.--Germination of four sizes of fourwing saltbush seeds

Seed source	Seed size[1]			
	Large	Medium	Small	Very small
	Percentage germination[2]			
Albuquerque, New Mexico	35	38	43	58
Tucson, Arizona	31	33	32	49
Average	33	36	38	54

1/ Seed diameters (inches): Large, 8/64 to 6/64; medium, 6/64 to 1/12; small, 1/12 to 1/14; very small, under 1/14.

2/ Based on 400 seeds each treatment.

Table 2.--Analysis of variance of fourwing saltbush seed germination by size classes

Source	Degrees of freedom	Sum of squares	Mean square	F
Seed source	1	102	102.00	14.19**
Seed size	3	529	176.33	24.52**
Interaction	3	18	6.00	0.83
Remainder (error)	120	863	7.19	

** Indicates highly significant differences.

Both moderate and heavy scarification, however, hastened the rate of germination (table 3). Under critical soil-moisture conditions the increased rate of germination after scarification would greatly facilitate the establishment of seedling stands.

Mechanical scarification is not a new technique. Practical methods are well established and a number of scarifying devices are on the market (6), but some improvisation may be necessary to control the operation with fourwing saltbush seeds. The paramount consideration, of course, should be the improvement of germination without damage to the seeds.

Table 3.--Effect of scarification on rate of germination of fourwing saltbush seed. Cumulative percent of total germination occurring by days

Day	Scarification treatment		
	Hammermilled	Moderate	Heavy
	Percent germination		
2	0	6	8
3	18	43	46
4	54	66	76
5	74	88	85
6	79	91	90
7	84	93	95
8	87	95	97
9	91	96	97
10	91	98	98
15	100	100	100

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